AD-A264 832

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

(2)

REPORT DATE	3. REPORT TYPE AND DATES COVERED ANNUAL 01 Nov 91 TO 31 Oct 92
4. TITLE AND SUBTITLE ADVANCED RESEARCH IN SKY SURVEILLANCE: A SEARCH FOR LOW-LUMINOSITY OBJECTS	5. FUNDING NUMBERS F49620-92-J-0051 61102F 2311 A1
6. AUTHOR(S) Dr Tom Gehrels	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Lunar & Planetary Laboratory University of Arizona Tucson, AZ 85721	8. PERFORMING ORGANIZATION REPORT NUMBER AFOSR-TR- 0284
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/NL 110 Duncan Avenue, Suite B115 Bolling AFB DC 20332-0001	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited	12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The new CCD was installed. Improvements were made in the software and in the operation and the system is working well. All through the year the telescope has been assigned for eighteen nights per month. Large numbers of main-belt asteroids have been found. It has been found that objects smaller than 2 meters occur two orders of magnitude more frequently that expercted from extrapolation of the size-frequency relation of the larger near-Earth objects. The design of the new 1.8-meter Spacewatch Telescope has begun.

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT (U)	18. SECURITY CLASSIFICATION OF THIS PAGE (U)	19. SECURITY CLASSIFICATION OF ABSTRACT (U)	20. LIMITATION OF ABSTRACT (UL)

Progress Report

Grant # F49620-92-J-0051 DEF

P.I., Tom Gehrels

The "thinned" 2048 x 2048 Tektronix CCD that had been bought with funds from Grant # F49620-92-J-0051 DEF was installed during the summer of 1992 and was first on the telescope in September. There were, however, problems in the operations so the October run was interrupted to take the CCD and all the controlling equipment into the Lab for extensive testing. Improvements were made in the software and in the operation and now the system is working beautifully. That CCD has pixel size 24 microns and the quantum efficiency is reportedly 80%. The limiting magnitude is V = 21.2 (4 sigma detection) for 146.5 secs integration time (at equator; scanning with drive off). All through the year we have been assigned to the telescope 18 nights per month at the 0.9-meter f/5 Spacewatch Telescope of the University of Arizona on Kitt Peak. The weather has been far below normal due to El Niño.

Large numbers of main-belt asteroids are found, which are made available on e-mail in near-real time to whomever wants it. The total number of asteroids that has thus been reported is about 18,000. The data are very welcome at the Minor Planet Center where their astrometry is combined in several cases with other observations made elsewhere and thereby permanent orbits are obtained. New objects we provide astrometry for are shown in the Table below.

With our CCD scanning we are finding not only new objects, but even new types of objects as is seen in the Table which is an update of the Spacewatch discoveries. We inspect the scans for faint trails and find small objects. Smaller than 0.02 km they occur two orders of magnitude more

frequently than expected from extrapolation of the size-frequency relation of the larger near-Earth objects. (5145) Pholus also was an exciting discovery because it moves in chaotic orbit in the Saturn-Uranus-Neptune region of the solar system.

We are just beginning to design the new 1.8-meter Spacewatch Telescope. Even at the 0.9-meter there is not a static situation but rather a continuing development of fine tuning the observing techniques and the software.

Identification	Perihelion distance (AU)	Aphelion distance (AU)	Incli. nation (deg)	Dia- meter (km)	Date of Discovery	Remarks
P/Spacewatch	1.54	4.8	10.0	-	8 Sep.,1991	
1991 RJ2	1.26	3 2	9.0	0.7	2 Oct.,1991	
1991 TT	1.00	1.4	14.8	0.03	6 Oct.,1991	
1991 TU	0.94	1.9	7.7	0.009	7 Oct.,1991	
1991 VA	0.93	1.9	6.5	0.02	1 Nov.,1991	
1991 VG	0.97	1.1	0.3	0.014	6 Nov.,1991	
1991 XA	0.98	3.6	5.3	0.09	3 Dec.,1991	
1992 AD	8.7	32.3	24.7	>140	9 Jan.,1992	(5145) Pholus
1992 AE	1.24	3.2	6.4	4.5	10 Jan.,1992	
1992 BA	1.25	1.4	10.5	0.4	27 Jan.,1992	peculiar orbit
1992 DU	0.96	1.4	25.1	0.05	26 Feb.,1992	
1992 HF	0.61	2.2	13.3	0.5	24 Apr.,1992	
Spacewatch	3.05	--	124.5	--	1 May, 1992	Comet 1992 h
1992 JG	1.30	3.2	5.6	1.8	2 May, 1992	deep Mars crosser
1992 JD	1.00	1.1	13.6	0.05	3 May, 1992	
1992 SY	0.99	3.4	8.2	1.1	27 Sep.,1992	
1992 SZ	1.18	3.2	9.3	0.6	28 Sep.,1992	
1992 TB	0.73	2.0	28.1	1.8	2 Oct.,1992	
1992 WA	1.09	1.5	4.6	0.6	19 Nov.,1992	peculiar orbit
1992 XA	1.82	5.2	25.0	1.1	1 Dec.,1992	a Griqua?
1992 YD3	1.01	1.3	27.8	0.03	27 Dec.,1992	
1993 BD2	1.29	3.0	25.7	0.9	22 Jan.,1993	
1993 BD3	1.02	2.2	0.9	0.03	26 Jan.,1993	1991 CB1
1993 BV3	0.68	2.7	14.6	1.1	26 Jan.,1993	
1993 BU3	1.17	3.6	5.3	0.3	29 Jan.,1993	

1991 VG may be an upper stage of a spacecraft. In addition to the discoveries, Spacewatch rediscovered 3288 (an Apollo), 3122 (an Amor), P/Shoemaker-Levy 5, P/Gunn and (2060) Chiron (!) and made the first ground-based observation of a cometary dust trail (for P/Faye). 1991 RJ2 had been discovered by Helin in September, but it was then lost. 1992 WA is 1991 ML, which would have been lost but for this rediscovery. We also obtained preliminary orbits for objects that looked promising, namely a Trojan, a Hilda, a Flora, 5 Mars-Crossers and 3 Hungarias. Diameters are for an assumed average geometric albedo of 0.06.

Relevant Publications

Gehrels, T. (1991). Scanning with Charge-Coupled Devices. *Space Science Reviews* 58, pp. 347-375.

Rabinowitz, D. L. (1991). Detection of Earth-Approaching Asteroids in Near Real Time. *Astron. J.* 101, pp. 1518-1559.

Scotti, J. V., Rabinowitz, D. L., and Marsden, B. G. (1991). Near Miss of the Earth by a Small Asteroid. *Nature* 354, pp. 287-289.

Rabinowitz, D. L. (1992). The Flux of Small Asteroids Near the Earth. *Asteroids, Comets, Meteors*, edited by Alan W. Harris and Edward Bowell, Lunar & Planetary Inst., Houston, pp. 481-485.

Scotti, J. V., Gehrels, T. and Rabinowitz, D. L. (1992). Automated Detection of Asteroids in Real-Time with the Spacewatch Telescope. *Asteroids, Comets, Meteors*, edited by Alan W. Harris and Edward Bowell, Lunar & Planetary Inst., Houston, pp. 541-544.